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BY

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COAL-MINE EXPLOSIONS AND FIRES IN THE UNITED STATES DURING THE FISCAL YEAR ENDED JUNE 30, 1934 [1]

By D. Harrington[2] and W. J. Fene[3]

That fatalities from mine explosions can be very much reduced from the experience of past years if not wholly eliminated was fairly well demonstrated during the fiscal year ended June 30, 1934, there being only 28 deaths in the United States from explosions during this period. This is by far the lowest number of fatalities from explosions in the history of coal mining in the United States insofar as records are available. Although the frequency of occurrence of explosions has not decreased greatly during the past 6 years, there has been a marked decrease in severity, indicating that our coal-mining people are taking more effective precautions to prevent the spread of explosions. Pennsylvania is a good example of what may be done in reducing both the frequency and the severity of explosions; by the adoption of up-to-date safety measures, Pennsylvania bituminous mines now have the enviable record of only one major explosion disaster in more than 5 years, and the one major explosion which did occur cost but 7 lives although 277 persons were exposed; their lives were saved because rock-dusting prevented the spread of the flame and violence.

Many of our other mining States are making definite progress in working mines without disastrous explosions and fires; some of these, like Alabama, West Virginia, Indiana, Wyoming, and others now operating with few, if any, explosions, have had anything but a favorable record in the past.

SUMMARY OF MINE EXPLOSIONS BY STATES

Table 1 gives the results of studies of 26 explosions in six States, with a total of 28 deaths during the fiscal year ended June 30, 1934. This tabulation gives data on all explosions in mines of the United States to which the attention of the Safety Division of the Bureau of Mines was called during the fiscal year ended June 30, 1934. The number of ignitions (26) is greater than that for the previous fiscal year (22); however, the number of deaths (28) is considerably less than that for the previous year (122).

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[1] The Bureau of Mines will welcome reprinting of this paper, provided that the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6819."

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TABLE 1. - Summary of mine explosions by States, July 1, 1933 to June 30, 1934

State	Lighting used				Fatalities by ignition causes									
					Electricity		Open lights or smoking		Explosives		Unknown		Total	
	Open	Closed	Unknown or no. lights	Total mine explosions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions
Alabama	1	1	-	2	2	1	0	1	-	-	-	-	2	2
Kentucky	1	-	-	1	-	-	-	-	0	1	-	-	0	1
Pennsylvania	6	6	2	1/ 14	10	3	1	6	2	1	3	4	16	14
Virginia	1	1	1	2/ 3	1	1	1	2	-	-	-	-	2	3
Washington	-	2	-	2	0	1	-	-	0	1	-	-	0	2
West Virginia	-	4	-	4	8	4	-	-	-	-	-	-	8	4
Total United States, fiscal Year ended June 30, 1934	9	14	3	26	21	10	2	9	2	3	3	4	28	26
Total United States, fiscal Year ended June 30, 1934	7	14	1	22	25	8	63	8	29	4	5	2	122	22
Total United States, fiscal year ended June 30, 1932	3/ 15	3/ 15	3/ 4	3/ 34	11	10	33	15	42	5	1	3	87	33
Total United States, fiscal Year ended June 30, 1931	12	15	0	26	143	9	56	11	18	6	0	0	217	26
Total United States, fiscal Year ended June 30, 1930	8	25	1	34	154	18	21	8	24	6	0	2	199	34
Total United States, fiscal Year ended June 30, 1929	18	19	1	38	93	18	14	11	26	8	6	1	139	38

1/ 13 of these explosions were in anthracite mines. 2/ Includes 1 tipple explosion. 3/ Ignition of methane in metal mine.

The States with the greatest number of deaths from explosions were: Pennsylvania, 16 (9 in anthracite mines); West Virginia, 8; Alabama, 2; and Virginia, 2. The greatest number of ignitions listed, 14 (13 in anthracite mines) was for Pennsylvania; West Virginia was next with 4 ignitions; Virginia had 3 ignitions; Alabama and Washington had 2 each; and Kentucky had 1 ignition.

Only one major explosion occurred during the fiscal year, which killed 7 men, compared with 3 major explosions the previous year, with 91 deaths, and an average of 14 major explosions during the previous 4 years. This substantial reduction in the number of major explosions would indicate that greater precautionary measures of various kinds are being taken than have been done in the past.

Twenty-one persons were killed during the past fiscal year in mine explosions caused by electricity; this compares favorably with an average of 85 killed per year for the preceding 5 years. This represents approximately a 75-percent reduction in the number of deaths with only a 20-percent reduction in the number of ignitions from electrical causes; this probably indicates that greater precautions are being taken to prevent the propagation of explosions.

West Virginia had the greatest number of electrical ignitions (4), with 8 fatalities; Pennsylvania had 3 electrical ignitions, with 10 fatalities; Alabama had 1 electrical ignition, with 2 fatalities; Virginia had 1 electrical ignition, with 1 fatality, and Washington had 1 electrical ignition, with no fatalities.

Nine ignitions were caused by open lights (6 of which were in anthracite mines) compared with 8 in the previous fiscal year and an average of 11 during the previous 5 fiscal years. The deaths from explosions caused by open lights last year numbered 2 compared with 63 the previous year and an average of 36 during the previous 5 years. Ignitions by open lights were distributed by States as follows: Pennsylvania, 6 (all anthracite mines), with 1 death; Virginia, 2, with 1 death; and Alabama, 1, with no deaths. This is unquestionably the smallest number of deaths from explosions of open-light ignitions in any yearly period in the history of coal mining in the United States.

Explosions originating from blasting numbered 3, with 2 fatalities, compared with 4 explosions, with 29 fatalities, during the previous year and an average of 6 explosions and 28 fatalities during the previous 5 years. This also is a new low in fatalities in any one year in our coal mines in explosions with ignition by blasting. One explosion caused by explosives in Pennsylvania caused 2 deaths, and 1 explosion each in Kentucky and Washington did not result in any deaths. Probably other explosions were initiated by blasting during the year, but the above are the only ones which came under the notice of the Safety Division of the Bureau of Mines during the year.

Four explosions in which the cause of ignition could not be determined occurred in Pennsylvania, resulting in 3 deaths.

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RECORD OF EXPLOSIONS BY STATES

Table 2 shows the record of explosions during the past 6 fiscal years, by States. During the 6-year period, 179 ignitions caused 792 deaths, an average of 29.8 ignitions and 132 deaths per year. Table 2 lists only the explosions with which the Safety Division of the Bureau of Mines had contacts of some kind. Both the ignitions and deaths during the past year were much fewer than the average for the 6-year period, but there were four more ignitions than in the previous year. For the 6-year period (July 1, 1928 to June 30, 1934) Pennsylvania heads the list, both in total number of ignitions (50) and in deaths (141); Oklahoma ranks second in number of deaths (120), with only 9 ignitions. It is of interest to note that during the 6 years Kansas and Maryland had 1 ignition each with a total of 3 deaths (2 in Kansas and 1 in Maryland); Tennessee had 3 ignitions, without a fatality; and that Utah has gone 4 years without an ignition. It is also of interest to note that during the 6-year period there were 4.42 deaths per explosion and that Oklahoma leads all States, with an average number of 13.33 deaths per ignition, while some of the larger coal-producing States show a much lower death rate per ignition. If Oklahoma's record had been maintained during this period by all the States, there would have been 2,386 instead of 792 deaths from explosions. The difference in the severity of the explosions may be due to greater precautions in some of the States to prevent propagation of explosions. The low rate for Pennsylvania, where 50 ignitions occurred, may be partly explained by the fact that a large percentage of the ignitions occurred in anthracite mines, the coal dust of which is not explosive. No deaths resulted in 50 percent of the explosions occurring during the past year. The following coal-mining States and territories are not listed in table 2 as having had an explosion during the past 6 fiscal years; Alaska, Arkansas, Iowa, Michigan, Missouri, Montana, North Dakota, Texas, and Wyoming.

CAUSES OF EXPLOSIONS

Table 3 gives data as to causes of explosions in the United States during the past 6 fiscal years, as reported to the Safety Division of the United States Bureau of Mines. It will be noted that 179 explosions have been studied during the 6-year period, an average of practically 30 per year. There were 26 explosions during the fiscal year ended June 30, 1934, which is 4 more than occurred during the previous year and 4 fewer than the average number annually for the period. Seventy three (40.8 percent) of these explosions (an average of 12.2 per year) during the 6-year period were of electrical origin. Explosions of electrical origin caused 38.5 percent of the explosions during the past fiscal year, which is about 2 percent higher than the preceding year and about 2 percent lower than the average for the 6 years. During the first 2 years of this 6-year period electricity caused approximately 50 percent of the explosions. Apparently, greater care in the use of electricity underground has been responsible for the substantial decrease in electrical ignitions during the past 4 years.

TABLE 2. - Record of explosions by States during last 6 fiscal years

State	1928-29		1929-30		1930-31		1931-32		1932-33		1933-34		6-year totals		Averages per year		Average deaths per ignition
	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	
Alabama	13	7	8	4	0	2	4	5	-	-	2	2	27	20	4.5	3.3	1.35
California	0	1	7	2	12	1	0	1	0	1	-	-	19	6	3.2	1.0	3.18
Colorado	-	-	0	1	-	-	4	3	1	1	-	-	5	5	.8	.8	1.00
Illinois	0	3	10	2	2	1	3	3	54	1	-	-	69	10	11.5	1.7	6.90
Indiana	-	-	-	-	28	1	-	-	4	2	-	-	32	3	5.3	.5	10.63
Kansas	2	1	-	-	-	-	-	-	-	-	-	-	2	1	.3	.2	2.00
Kentucky	11	3	16	1	-	-	3	1	26	2	0	1	56	8	9.3	1.3	7.00
Maryland	-	-	-	-	-	-	1	1	-	-	-	-	1	1	.2	.2	1.00
New Mexico	-	-	-	-	8	3	-	-	14	1	-	-	22	4	3.7	.7	5.80
Ohio	3	3	1	2	88	3	-	-	-	-	-	-	92	8	15.3	1.3	10.25
Oklahoma	1	1	71	4	45	2	-	-	3	2	-	-	120	9	20.0	1.5	13.33
Pennsylvania	70	9	16	8	23	7	7	6	9	6	16	14	141	50	23.5	8.3	2.82
Tennessee	-	-	-	-	-	-	0	3	-	-	-	-	0	3	.0	.5	0.00
Utah	1	2	30	3	-	-	-	-	-	-	-	-	31	5	5.2	.8	6.20
Virginia	2	1	-	-	-	-	54	3	-	-	2	3	58	7	9.7	1.2	8.30
Washington	-	-	17	2	0	2	-	-	2	1	0	2	19	7	3.2	1.2	2.70
West Virginia	36	7	23	5	11	4	11	7	9	5	8	4	98	32	16.3	5.3	3.07
Total	139	38	199	34	217	26	87	33	122	22	28	26	792	179	132.0	29.8	4.42

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Table 3 shows that explosives were responsible for 11.5 percent of the explosion ignitions occurring during the last fiscal year, compared with 18.1 percent for the previous year and an average of 19.1 percent for the preceding 5 years. There have no doubt been numerous explosions due to explosives in the coal mines of the United States during the past 6 years in addition to the 32 listed in table 3, as many explosions originating from blasting which do not result in deaths or serious property damage may not come to the attention of the Safety Division personnel. The favorable reduction in explosions caused by explosives may be attributed chiefly to safer practices in the handling of explosives and to the increased use of permissible explosives.

Open lights were responsible for 9 (34.6 percent) of the explosions occurring during the past fiscal year; this was a slight reduction compared with the previous year, but is essentially the same as the average for the past 6 years.

The causes of 4 of the ignitions were unknown, which represents 15.4 percent of the total number of ignitions. In one of the ignitions listed under "unknown causes" it was supposed that gas might have been ignited by sparks from a pick; although it is possible to ignite gas by sparks from a pick experiments have shown that it is very difficult to do so. Another ignition listed under this heading, in which 1 man was killed and 5 were injured, was supposed to have been caused by gas being ignited by an old mine fire; this was only a supposition, and no definite cause was determined.

EXPLOSION FATALITIES, BY CAUSES

Table 4 compares explosion fatalities by causes and shows that during the past 6 fiscal years 792 fatalities occurred from explosions in the mines of the United States, an average of 153 per year. The record of 1934 - 28 killed - is by far the best as regards fatalities from explosions of any one year in United States mines since records have been available.

Explosions of electrical origin were responsible for 56.4 percent of the deaths in our mines during the past 6 fiscal years. During the past fiscal year 75 percent of the fatalities from explosions were from those of electrical origin, which is a considerable increase compared with the preceding 2 years.

Although there was increased activity in coal mining during the past year compared with the previous 2 years the fact that electricity was responsible for 38.5 percent of the explosions and 75 percent of the fatalities is evidence of carelessness or recklessness in the use of underground electrical equipment; this should occasion some little concern to our mining people, as it may not always be feasible to hold incipient explosions to a limited area.

TABLE 3. - Comparison of explosion - ignition causes, fiscal years 1929 to 1934, inclusive

Years	Ignition by electricity		Ignition by open lights or smoking		Ignition by explosives		Ignition by unknown causes		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1928-29	18	47.4	11	29.0	8	21.0	1	2.6	38	100
1929-30	18	52.5	8	23.5	6	18.0	2	6.0	34	100
1930-31	9	34.6	11	42.3	6	23.1	0	.0	26	100
1931-32	10	30.1	15	45.5	5	15.2	3	9.2	33	100
1932-33	8	36.4	8	36.4	4	18.1	2	9.1	22	100
1933-34	10	38.5	9	34.6	3	11.5	4	15.4	26	100
Total, 6 years	73	40.8	62	34.6	32	17.9	12	6.7	179	100
Average, 6 years	12.2	40.8	10.3	34.6	5.3	17.9	2	6.7	29.8	100

TABLE 4. - Comparison of explosion fatalities by ignition causes, fiscal years 1929 to 1934, inclusive

Years	Electricity		Open lights or smoking		Explosives		Unknown		Total	
	Number killed	Percent	Number killed	Percent	Number killed	Percent	Number killed	Percent	Number killed	Percent
1928-29	93	66.9	14	10.1	26	18.7	6	4.3	139	100
1929-30	154	77.5	21	10.5	24	12.0	0	0	199	100
1930-31	143	65.9	56	25.8	18	8.3	0	0	217	100
1931-32	11	12.7	33	38.0	42	48.2	1	1.1	87	100
1932-33	25	20.5	63	51.6	29	23.8	5	4.1	122	100
1933-34	21	75.0	2	7.1	2	7.1	3	10.8	28	100
Total, 6 years	447	56.4	189	23.9	141	17.8	15	1.9	792	100
Average, 6 years	74.5	56.4	31.5	23.9	23.5	17.8	2.5	1.9	132	100

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Open lights (or smoking) caused explosions resulting in 189 deaths during the past 6 fiscal years and in 23.9 percent of the total fatalities from explosions during this period. During the past year there were only 2 deaths (7.1 percent of the total) from this cause, which is by far the best record in many years. Six of the nine explosions caused by open lights during the year were in anthracite mines, and in some cases the open lights were being used where flame safety lamps were being used to test for gas. Where it is considered necessary or desirable to use flame safety lamps to test for gas, it is difficult to understand why the use of open flame lamps is permitted. Many mines, both anthracite and bituminous, have adopted closed lights during the past several years, and this is undoubtedly a material factor in the reduction of explosions caused by open lights. No explosions were charged to smoking during the past year insofar as the Bureau of Mines Safety Division has learned.

During the past 6 years 141 deaths (17.8 percent of the total killed during this period by explosions from all causes) have resulted from explosions caused by the misuse of explosives. A very satisfactory reduction in explosions caused by blasting is noted for the past year, there being only 2 deaths, representing 7.1 percent of the total killed by explosions. These two deaths resulted by an explosion caused by a "bulldozing" shot.

During the past 6 years 15 persons have been killed in United States mines in 12 explosions, the causes of which could not be ascertained by the Bureau of Mines Safety Division. There is almost always some difficulty in assessing a definite cause when an explosion occurs, because usually the person or agency responsible is put out of commission by the explosion; however, a fairly definite conclusion ordinarily can be reached, but in some cases (12 out of 179 in the past 6 fiscal years) it is not possible to assign a definite cause.

ELECTRICAL CAUSES OF EXPLOSIONS

Table 5 gives data relating to details of the causes of explosions of electrical origin in United States mines during the past 6 fiscal years, insofar as data are available to the United States Bureau of Mines Safety Division. During the 6-year period there were 73 ignitions of electrical origin, with 10 ignitions causing 21 fatalities during the past fiscal year. The greatest sources of electrical ignition in coal mines are trolley or cable-reel locomotives and nonpermissible mining machines; these two are responsible for approximately half of the electrical ignitions occurring during the 6-year period.

During the past fiscal year trolley or cable-reel locomotives were responsible for 50 percent of the electrical ignitions and 62 percent of the fatalities therefrom. The only major explosion of the year (in which 7 men were killed) was caused by a cable-reel locomotive. Five men were killed and 7 injured in 2 ignitions caused by electric arcs; one of these explosions was caused by an electric arc following a "bump", and the other was started by a wrecked trip of cars stirring up coal dust, which was ignited by an arc from the trolley wire.

TABLE 5. - Electrical causes of explosions, fiscal years 1929 to 1934, inclusive

Cause	Number of ignitions, by fiscal years						Total 6 years	Number killed		Number injured	
	1929[1]	1930[2]	1931[3]	1932[4]	1933[5]	1934		1933	1934	1933	1934
Trolley or cable-reel locomotive	[6] 5	5	1	1	4	5	[6] 20	6	13	3	4
Nonpermissible mining machine	[7] 5	5	3	3	1	0	[7] 16	2	0	4	0
Nonpermissible electric motor	4	3	0	0	0	0	7	0	0	0	0
Nonpermissible shot-firing battery or circuit	0	[8] 2	[8] 3	1	0	1	2	0	0	0	3
Cable nips or cable blow-outs	0	2	0	0	0	1	3	0	1	0	3
Nonpermissible electric drills	0	0	0	2	0	1	3	0	2	0	3
Nonpermissible storage-battery locomotive	1	1	2	0	0	0	4	0	0	0	0
Nonpermissible electric hoist	0	0	0	0	1	0	1	1	0	1	0
Faulty wiring	2	2	0	0	0	0	4	0	0	0	0
Trolley wire	1	0	2	1	0	0	4	0	0	0	0
Electric arc	2	0	1	2	1	2	8	2	5	0	7
Signal wire	0	0	0	0	1	0	1	14	0	0	0
Total ignitions	18	18	9	10	8	10	73	25	21	8	20

[1] See Inf. Circ. 6178.
[2] See Inf. Circ. 6419.
[3] See Inf. Circ. 6540.
[4] See Inf. Circ. 6680.
[5] See Inf. Circ. 6761.
[6] 1 not included in totals; may have been open light, hence is assigned to open lights or smoking.
[7] 1 not included in totals; may have been from smoking, hence is assigned to open lights or smoking.
[8] Not included in totals; may have been from overcharged shots, hence is assigned to explosive accidents.

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In most of the electrical ignitions there was evidence of carelessness in maintaining good ventilation or adequate rock-dusting in the places where the ignitions occurred. Other factors concerned in some of these electrical ignitions were: Lack of proper inspection, working face driven too far ahead of the last open crosscut without proper provision for keeping air circulating at the face, and use of haulageways as return airways.

COMPARISON OF LIGHTING IN MINES WHERE EXPLOSIONS OCCURRED DURING THE PAST 6 YEARS

In a comparison of lighting in mines where explosions occurred during the past 6 fiscal years, as shown in table 6, it is observed that of 181 explosions listed 69 (38.1 percent of the total) occurred in open-light mines, that 102 (56.4 percent) were in closed-light mines, and that in 10 (5.5 percent) the lighting practice was unknown. The fact that the greater number of these explosions occurred in closed-light mines would indicate either lack of appreciation of the hazards of inadequate ventilation, nonpermissible electrical equipment and nonpermissible explosives, or only a half-hearted attempt to control ignitions of gas or dust. In some few of the explosions that occurred during the year, criminal negligence might be charged, and while the year's record was good the element of "luck" was responsible in several instances in holding the death list low. Although our mining people now know (or at least ought to know) the precautions necessary to avoid explosion disasters and many of them take many if not most of the main precautions, the great majority prefer to take chances rather than to exert themselves or their organizations to take necessary precautions.

TABLE 6. - Comparison of lighting in mines where explosions occurred, fiscal years 1929 to 1934, inclusive

Years	Open lights		Closed lights		Lighting unknown		Total	
	Number of explosions	Per cent	Number of explosions	Per-cent	Number of explosions	Per-cent	Number of explosions	Per-cent
1929	18	47.4	19	50.0	1	2.6	38	100
1930	8	23.5	25	73.5	1	3.0	34	100
1931	12	44.4	15	55.6	0	.0	1/ 27	100
1932	15	44.1	15	44.1	4	11.8	1/ 34	100
1933	7	31.8	14	63.6	1	4.6	22	100
1934	9	34.6	14	53.9	3	11.5	26	100
Total, 6 years	69	38.1	102	56.4	10	5.5	2/181	100

1/ 1 mine had mixed (open as well as closed) lighting.
2/ 2 mines had mixed (open as well as closed) lighting.

MINE FIRES

Although mine fires have potentialities of causing great loss of life and tremendous property damage, the mines of the United States have been fortunate during the past decade in not experiencing a fire causing large loss of life; however, there have been a number of fires that have caused considerable property damage and some mining companies persist in the use of methods or equipment which cause mine fires practically weekly throughout the year.

During the past fiscal year 18 mine fires were called to the attention of the United States Bureau of Mines Safety Division. Unquestionably, scores of other fires were detected and extinguished promptly without much damage or were handled quietly and more or less secretly by the mine involved, hence their occurrence was not made public.

Table 7 shows that most of the fires in the fiscal year 1934 and brought to the attention of the Bureau of Mines Safety Division, occurred in Colorado, there being 5 fires reported with 1 fatality in the State during the year. Four fires occurred in Kentucky, 1 of which needlessly cost the lives of 5 men. Three fires occurred in Alabama, 2 in Pennsylvania and 1 each in Indiana, New Mexico, Virginia, and West Virginia. It is noted that electricity was responsible for 4 of the fires, that explosives were responsible for 5 fires, and that the causes of 9 of the fires are listed as miscellaneous. Under the 9 fires listed under miscellaneous, 3 are of unknown origin; 3 were of spontaneous origin; in 1 a cigarette or match was thrown into a timber pile; in another a fire in the fanhouse spread to the mine; and in another a wooden tipple burned and trapped 5 men in the mine, who were later rescued uninjured. The total number of fires (18) during the fiscal year 1934 is a reduction compared with the average (24) for the preceding 4 years. However, the number of deaths (6) due to fires is an increase compared with the preceding 2 years.

SUMMARY

It is encouraging to note that during the more or less recent past the trend in the number of explosions annually in our mines has been definitely downward. The record for the fiscal year July 1, 1933 to June 30, 1934, in which 28 were killed by explosions, is remarkable not only because of the marked decrease in fatalities but also because it was expected that deaths from explosions might rise because of the considerably increased mining activities during several months of the year in a number of the important coal-producing States.

TABLE 7. - Summary of mine fires by States - July 1, 1930 to June 30, 1934

	Lights				Fatalities by ignition causes								Total	
					Electricity		Open lights		Explosives		Miscellaneous			
State	Open	Closed	Unknown	Total	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions
Alabama	2	1	-	3	-	-	-	-	-	2	-	1	-	3
Colorado	3	1	1	5	-	-	-	-	-	1	1	4	1	5
Indiana	1[1/]	-	-	1	-	-	-	-	-	-	-	1	-	1
Kentucky	3	-	1	4	-	1	-	-	5	2	-	1	5	4
New Mexico	-	1	-	1	-	1	-	-	-	-	-	-	-	1
Pennsylvania	-	1	1	2	-	1	-	-	-	-	-	1	-	2
Virginia	1	-	-	1	-	-	-	-	-	-	-	1	-	1
West Virginia	-	1	-	1	-	1	-	-	-	-	-	-	-	1
Total fiscal year, ended June 30, 1934	10	5	3	18	-	4	-	-	5	5	1	9	6	18[3/]
Total fiscal year, ended June 30, 1933[4/]	12[2/]	6	9	27	-	7	-	-	-	2	2	18	2	27
Total fiscal year, ended June 30, 1932[5/]	8	5	8	21	1	8	-	-	-	3	-	10	1	21
Total fiscal year, ended June 30, 1931[6/]	12	7	5	24	-	7	5	3	-	5	18	9	23	24
Total fiscal year, ended June 30, 1930[7/]	7	8	9	24	2	9	3	6	-	3	-	6	5	24

[1/] Wood tipple burned, trapped 5 men in mine.
[2/] Includes 2 metal mines.
[3/] 3 of these fires were of spontaneous combustion.
[4/] See Inf. Circ. 6761.
[5/] See Inf. Circ. 6680.
[6/] See Inf. Circ. 6540.
[7/] See Inf. Circ. 6419.

Note:- This tabulation includes data only on mine fires to which the attention of the Bureau of Mines Safety Division was called.

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Table 8 shows the major coal-mine explosions and fires (in which 5 or more were killed) in the United States during the past 33 years, a calendar-year basis. It is shown that the best years during this period, insofar as explosions and fires are concerned, were 1918, 1921, 1931, and 1933; in the last year only 1 major explosion occurred, killing 7 men. The decline in frequency and severity of explosions and fires during the past 5 years is believed to be due primarily to (1) the increased activities of the various State mine-inspection departments, especially along the line of educational work and demand for more rigid adherence to State laws; (2) the growing realization of the economic waste of all accidents, including explosions, and the more or less general acceptance of responsibility for accident occurrence by the mine operators; and (3) the more widespread dissemination of safety data by the United States Bureau of Mines and other safety organizations.

It is definitely known that mine explosions and fires can be prevented by the adoption of well-known preventive measures, the expense of which is negligible compared with probable ultimate savings. The adoption of these preventive measures is a matter of the operators' realization of their responsibility and education as to the seriousness of existing or potential hazards.

Salient points brought out in the study of mine explosions and fires in mines of the United States by the Safety Division of the United States Bureau of Mines for the year ending June 30, 1934 are as follows:

1. Twenty-six explosions were studied, 13 in bituminous mines and 13 in anthracite mines, compared with 22 for the previous year and an average of 31 per year for the previous 5 fiscal years.

2. Explosions took 28 lives last year compared with 122 the previous year and an average of 153 annually for the previous 5 fiscal years. The 13 explosions in anthracite mines during the past year resulted in 9 deaths, while the 13 explosions occurring in bituminous mines resulted in 19 deaths.

3. The one major explosion during the past fiscal year accounted for 7 deaths, while the 25 lesser explosions accounted for 21 deaths. In 13 of the explosions no deaths resulted. The past fiscal year holds an all-time record of avoidance of major explosion disasters and for the least number of deaths by explosions in American mines insofar as records are available.

4. Nine explosions occurred in open-light mines compared with 7 the previous year and an average of 10 annually for the previous 5 fiscal years; 14 explosions were in closed-light mines compared with the same number the previous year and an average of 17.6 annually for the previous 5 fiscal years. Some of the open-light mines in which explosions occurred were known to give off explosive gas, and in some instances firebosses employed in mines used flame safety lamps for testing for gas and yet ignited gas with open flame lamps.

TABLE 8. - Major coal mine explosions and fires in the United States during the past 33 years in which 5 or more were killed

Year	Number	Killed		Total
		Explosions	Fires	
1901	10	98	36	134
1902	11	391	10	401
1903	8	227	-	227
1904	5	220	5	225
1905	15	265	19	284
	49	1,201	70	1,271
1906	12	188	8	196
1907	14	889	5	894
1908	8	293	38	331
1909	16	212	268	480
1910	17	455	10	465
	67	2,037	329	2,366
1911	12	322	72	394
1912	11	222	9	231
1913	7	459	-	459
1914	6	268	5	273
1915	10	253	-	253
	46	1,524	86	1,610
1916	11	154	-	154
1917	7	251	-	251
1918	4	41	13	54
1919	8	89	20	109
1920	7	47	6	53
	37	582	39	621
1921	5	21	13	34
1922	11	269	-	269
1923	10	296	-	296
1924	10	458	-	458
1925	14	270	-	270
	50	1,314	13	1,327
1926	16	348	-	348
1927	8	155	-	155
1928	14	326	-	326
1929	6	146	-	146
1930	12	217	-	217
	56	1,192	-	1,192
1931	6	56	-	56
1932	6	145	-	145
1933	1	7	-	7
	13	208	-	208
Grand total 1901-33	318	8,058	537	8,595

5. Ten explosions, causing 21 deaths, were of electrical origin compared with 8 explosions and 25 deaths for the previous year. Although the number of explosions caused by electricity increased the deaths from this cause decreased. Explosions of electrical origin averaged 12.6 in number annually for the previous 5 fiscal years, and deaths averaged 85 annually for the same period; the past 3 fiscal years show a decided improvement in this phase of explosion occurrence in mines of the United States.

6. West Virginia, with 4 explosions, ranks first in the number of explosions caused by electricity during the year, and Pennsylvania, with 10 fatalities, ranks first in the number of deaths from this cause.

7. Trolley and cable-reel locomotives continue to be the greatest source of electrical explosions, accounting for 5 or 50 percent of the electrical explosions and 21 of the deaths during the year; electric arcs were responsible for 2 explosions, and a shot-firing circuit, cable nips, and nonpermissible electric drill were responsible for 1 each.

8. Nine explosions, with 2 deaths, were caused by open lights or smoking, compared with 8 explosions and 63 deaths in the previous year and an average of 10.6 explosions with 37.4 deaths during the 5 previous fiscal years. The great reduction during the past year in the number of deaths per explosion caused by open lights may be accounted for by the fact that 6 of the 9 explosions occurred in anthracite mines and dust entered into the explosions little if at all.

9. Three explosions and 2 deaths were caused by the use (or more correctly misuse) of explosives compared with 4 explosions and 29 deaths from this cause during the previous year and with an average of 5.8 explosions and 28 deaths during the previous 5 fiscal years. The two deaths caused by explosives during the past year resulted from a "bulldozing" shot igniting gas. As long as bulldozing shots are used they are very likely to cause accidents of one kind or another.

10. Rock dust was used to some extent in at least 7 of the mines in which explosions occurred during the past fiscal year. In two of the mines in which explosions occurred rock dust is credited with stopping the spread of the explosions, and it is believed that this saved the lives of many if not all of the approximately 335 men who were in these mines at the time.

11. Twenty-three of the explosions during the past year were initiated by gas and 3 by coal dust.

12. The underlying cause of at least 23 of the 28 deaths (82 percent) resulting from explosions during the past year was defective ventilation, which was manifest both in open- and closed-light mines.

13. The severity of explosions last year was reduced approximately 80 percent as compared to the average for the preceding 5 years. The average number of deaths per explosion last year was 1.08 as compared with an average of 5 deaths per explosion for the preceding 5 years.

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14. During the fiscal year 1934, 18 mine fires were reported by the personnel of the Safety Division of the United States Bureau of Mines, compared with an average of 24 fires per year for the preceding 4 years.

15. During the past fiscal year 5 mine fires were reported in Colorado, 4 in Kentucky, 3 in Alabama, 2 in Pennsylvania, and 1 each in Indiana, Virginia and West Virginia.

CONCLUSIONS

The data in this publication were compiled in the same manner as in previous years (see Information Circulars 6178, 6419, 6540, 6680, and 6761) and embody only facts brought out through study thereof by field employees of the United States Bureau of Mines Safety Division. Although an attempt is made to obtain data on every explosion that occurs in the United States some of the less destructive are not brought to the attention of the Bureau early enough to allow an investigation to be made; rarely, if ever, however, does the Bureau fail to get fairly complete data on mine explosions in which more than one life is lost or in which a considerable amount of property is damaged. Hence the data in these publications are relatively complete, especially as to those explosions causing loss of more than one life. The data on fires are by no means as complete as those for explosions, and there is reason to believe that scores of fires in both coal and metal mines occur annually without having been made known to the United States Bureau of Mines or even the State inspection forces. Mine fires occur almost daily in some coal mines, particularly at shot-firing time or where the coal fires spontaneously, and fires of electrical origin or from open lights are not unusual in metal mines.

A study of the data available on explosions and fires in the United States during the past 5 or 6 years reveals an encouraging reduction in the frequency and severity of these disasters.

For the 15-year period before 1929 mine explosions took an average toll of about 265 lives annually in the United States; since that date the number of fatalities from explosions has been reduced to an annual average of 132, the last fiscal year having an all-time low record, with only 28 persons killed by gas or dust explosions in our mines.

Unquestionably, mine explosions are preventable, and operation of the coal mines of the United States for an entire year with more than 350,000,000 tons of coal produced and only 28 deaths from mine gas or dust explosions would almost justify the prediction (or at least the hope) that our mines will soon see a year without mine explosions or deaths caused thereby. Very probably that year will not be seen for some time to come, and the good record set during the past fiscal year probably will not be approached again for many years. Never-the less, if our mining people use entirely feasible and wholly reasonable precautions, there is good reason to believe that our mines will continue in the future to have numerous years with fewer than 50 persons killed in mine explosions. However, our mines are going to continue to have numerous explosions and some of them are likely to result in many fatalities as long as our mining people persist in following many present-day dangerous practices, such as using open lights, nonpermissible electrical equipment, and nonpermissible explosives, blasting during the working shift, failing to rock dust adequately and to recognize all mines as potentially gassy, and numerous others, all of which are easily remedied or avoidable if the will to do so is present and reasonable effort is exerted.